

## Claims

[c1] **WHAT IS CLAIMED IS:**

1. A protein body (forisome) derivable from Fabaceae, wherein the protein body has a reversible, anisotropic contractability such that:

the protein body becomes thicker in a direction perpendicular to a longitudinal axis of the protein body and shorter along the longitudinal axis of the protein body when increasing a calcium ion concentration in a medium surrounding the protein body past a threshold value of approximately 30 nM and the protein body becomes thinner in the direction perpendicular to the longitudinal axis and longer along the longitudinal axis when decreasing the calcium ion concentration below the threshold value of approximately 30 nM; and

the protein body becomes thicker in the direction perpendicular to the longitudinal axis when increasing a pH value of a medium surrounding the protein body to a value above approximately 9.5 without becoming shorter along the longitudinal axis and the protein body becomes thinner in the direction perpendicular to the longitudinal axis without becoming longer along the longitudinal axis when decreasing the pH value below ap-

proximately 9.5.

- [c2] 2. The protein body according to claim 1, comprising a first protein having a molecular weight in the range of approximately 55–65 kDa and a second protein having a molecular weight in the range of 53–63 kDa.
- [c3] 3. A protein body according to claim 2, wherein, when digesting the first and second proteins by trypsin, the following peptides are found:  
Leu-Gln-Asp-Asn-Pro-Gln-Glu-Val-Ile-Lys (seq. ID No. 1);  
Glu-Gly-Phe-Asp-Ile-Ala-Phe-Lys (seq. ID No. 2);  
and wherein the first protein further contains the fragments:  
Glu-Val-Thr-Ser-Val (seq. ID No. 3);  
Val-Met-Glu-Val-Ser-Trp-His-Tyr-Lys-(seq. ID No. 4);  
Ala-Thr-Asp-Pro- (seq. ID No. 5).
- [c4] 4. The protein body according to claim 1, having a length of approximately 1 µm to approximately 40 µm and a diameter perpendicularly to the length of approximately 1 µm to approximately 10 µm.
- [c5] 5. The protein body according to claim 4, comprising a first protein having a molecular weight in the range of approximately 55–65 kDa and a second protein having a

molecular weight in the range of 53–63 kDa.

- [c6] 6. A protein body according to claim 5, wherein, when digesting the first and second proteins by trypsin, the following peptides are found,  
Leu–Gln–Asp–Asn–Pro–Gln–Glu–Val–Ile–Lys (seq. ID No. 1);  
Glu–Gly–Phe–Asp–Ile–Ala–Phe–Lys (seq. ID No. 2);  
and wherein the first protein further contains the fragments:  
Glu–Val–Thr–Ser–Val (seq. ID No. 3);  
Val–Met–Glu–Val–Ser–Trp–His–Tyr–Lys–(seq. ID No. 4);  
Ala–Thr–Asp–Pro– (seq. ID No. 5).
- [c7] 7. The protein body according to claim 1, wherein the contractibility along the longitudinal axis is up to approximately 30 % accompanied by an expansion perpendicular to the longitudinal axis of up to approximately 100 %.
- [c8] 8. A protein of the protein body of claim 2, having a molecular weight in the range of approximately 55–65 kDa, comprising or consisting of at least one of the sequences (read N-terminal to C-terminal):  
Leu–Gln–Asp–Asn–Pro–Gln–Glu–Val–Ile–Lys (seq. ID No. 1);  
and

Glu-Gly-Phe-Asp-Ile-Ala-Phe-Lys (seq. ID No. 2).

[c9] 9. A fragment of the protein of claim 8, comprising or consisting of at least one of the sequences (read N-terminal to C-terminal):

Leu-Gln-Asp-Asn-Pro-Gln-Glu-Val-Ile-Lys (seq. ID No. 1);

and

Glu-Gly-Phe-Asp-Ile-Ala-Phe-Lys (seq. ID No. 2).

[c10] 10. A protein of the protein body of claim 2, having a molecular weight in the range of approximately 53-63 kDa, comprising or consisting of at least one of the sequences (read N-terminal to C-terminal):

Leu-Gln-Asp-Asn-Pro-Gln-Glu-Val-Ile-Lys (seq. ID No. 1);

and

Glu-Gly-Phe-Asp-Ile-Ala-Phe-Lys (seq. ID No. 2).

[c11] 11. A fragment of the protein of claim 10, comprising or consisting of at least one of the sequences (read N-terminal to C-terminal):

Leu-Gln-Asp-Asn-Pro-Gln-Glu-Val-Ile-Lys (seq. ID No. 1);

and

Glu-Gly-Phe-Asp-Ile-Ala-Phe-Lys (seq. ID No. 2).

[c12] 12. A protein of the protein body of claim 2, having a molecular weight in the range of approximately 55–65 kDa, comprising or consisting of the sequences (read N-terminal to C-terminal):

Glu–Val–Thr–Ser–Val (seq. ID No. 3);

VaL–Met–Glu–Val–Ser–Trp–His–Tyr–Lys–(seq. ID No. 4);

Ala–Thr–Asp–Pro– (seq. ID No. 5).

[c13] 13. The protein according to claim 12, further containing at least one of the following amino acid sequences:

Leu–Gln–Asp–Asn–Pro–Gln–Glu–Val–Ile–Lys (seq. ID No. 1);

and

Glu–Gly–Phe–Asp–Ile–Ala–Phe–Lys (seq. ID No. 2).

[c14] 14. A fragment of the protein of claim 12, comprising or consisting of the sequences (read N-terminal to C-terminal):

Glu–Val–Thr–Ser–Val (seq. ID No. 3);

VaL–Met–Glu–Val–Ser–Trp–His–Tyr–Lys–(seq. ID No. 4);

Ala–Thr–Asp–Pro– (seq. ID No. 5).

[c15] 15. The fragment according to claim 14, further containing at least one of the following amino acid sequences:

Leu–Gln–Asp–Asn–Pro–Gln–Glu–Val–Ile–Lys (seq. ID No. 1);

and

Glu–Gly–Phe–Asp–Ile–Ala–Phe–Lys (seq. ID No. 2).

[c16] 16. A method for isolating protein bodies of claim 1, wherein the method comprises the steps of:  
A) obtaining phloem of a plant of the family Fabaceae;  
B) destroying the cells of the phloem;  
C) preparing a suspension of the destroyed cells of step B);  
D) filtering the suspension;  
E) separating the protein bodies from other components of the suspension by gradient centrifugation.

[c17] 17. The method according to claim 16, wherein in the step D) a Nycodenz solution is used for gradient centrifugation, wherein in the step C) the suspension contains a medium containing KCl in a suitable buffer.

[c18] 18. The method according to claim 16, wherein the plant is selected from the family of Vicia faba.

[c19] 19. A method of operating micro tweezers, comprising the steps of:  
connecting at least one protein body of claim 1 to two opposed spring arms of micro tweezers;  
increasing a concentration of calcium ions in a medium surrounding the at least one protein body from a value significantly below 30 nM to a value significantly above

30 nM.

[c20] 20. A method for operating a display element for a change of a calcium ion concentration from significantly below 30 nM to significantly above 30 nM or for change of the pH value from below pH 9.4 to pH 10.0 in a medium, the method comprising the steps of: connecting a protein body of claim 1 having a suitable size to two opposed spring arms having tips that upon contraction of the protein body contact one another, wherein the spring arms and the tips are configured such that when the tips contact one another an electric circuit is closed and electric current flows in the electric circuit; using the electric current flow or interruption of the electric circuit as a signal for indicating that the calcium ion concentration has increased to a value significantly above 30 nM or has dropped to a value significantly below 30 nM or that the pH value has risen above pH 10.0 or dropped below pH 9.4.